

# NATIONAL TASK FORCE ON TEACHER EDUCATION IN PHYSICS

## PREPARING HIGH SCHOOL PHYSICS TEACHERS TO BUILD A 21<sup>ST</sup> CENTURY STEM-CAPABLE WORKFORCE

### *Signatories*

Over the past 20 years, academic, business, and governmental authorities have warned that U.S. science education needs a drastic overhaul, particularly in the physical sciences. These increasingly urgent warnings are prompted in part by a wide and growing array of measures that show science education in the United States lags behind much of the rest of the world, and that in some cases, the gap is growing. Many factors contribute to this deficiency in science education. A very important factor is the preparation of qualified high school physics teachers.

With the U.S. economy ever more dependent on STEM (science, technology, engineering, and mathematics) skills, some knowledge of physics, a foundational science, is essential for all citizens, including professionals in STEM and numerous other fields, and many government and business leaders. Despite recent remarkable increases, only about one third of U.S. high school graduates take a class in physics. By contrast, many other developed countries require secondary school students to take multiple years of physics instruction.

A primary challenge of providing physics education is the dramatic shortage of teachers with even minimal qualifications. Each year, about 3,000 teachers find themselves in front of a high school physics classroom for the first time. And yet, fewer than half of the teachers of high school physics have a major or minor in physics or physics education, or any preparation specifically devoted to the teaching of physics. Indeed, school districts report that the urgency in fulfilling the need for qualified teachers is more pressing in physics than in any other academic subject area.

To address these national crises in STEM education, we make these three recommendations:

1. All US students should have the opportunity to take at least one year of a high quality physics course in high school.
2. Colleges and universities should expand and intensify their efforts to achieve a national goal of educating 3,000 new teachers of physics per year.
3. Teachers should be prepared at least at an acceptable level, and preferably at recommended or exemplary levels, described below:



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The *acceptable* professional preparation needed for a beginning teacher of physics includes:

- a. An undergraduate major or minor in physics.
- b. University-based pedagogical preparation, including physics-specific teaching experiences mentored in person by an experienced teacher, leading to initial licensure.

The *recommended* professional preparation needed for a beginning teacher of physics includes:

- a. An undergraduate major or minor in physics with coursework employing teaching practices informed by findings published in the physics education research literature.
- b. University-based pedagogical preparation in a program leading to licensure, including preparation that incorporates physics-specific pedagogy and physics-specific teaching experiences mentored in person by an experienced physics teacher.
- c. Continued mentoring and professional development of novice teachers through “learning communities” that connect novices with expert K-12 physics teachers and university faculty. These learning communities will provide forums in which physics educators can collectively address instructional challenges, share lesson ideas, and continue to grow and develop professionally.

The *exemplary* professional preparation of beginning teachers of physics includes the following physics-specific elements, as described in further detail in the recommendations of the National Task Force on Teacher Education in Physics (<http://www.ptec.org/webdocs/TaskForce.cfm>):

- a. An undergraduate major or minor in physics with coursework employing teaching practices informed by findings published in the physics education research literature.
- b. A program that leads to deep conceptual understanding of physics and the ability to apply concepts to quantitative problems and real-life applications.
- c. An experiential program that develops facility in designing and carrying out physics experiments and carefully analyzing the results.
- d. Multiple physics-specific pedagogy courses and physics-specific teaching experiences mentored by individuals with deep knowledge of high school teaching contexts, high school physics curricula, relevant student ideas, productive instructional approaches, and effective assessment methods.
- e. Continued mentoring and professional development of novice teachers through “learning communities” that connect novices with expert K-12 physics teachers and university faculty. These learning communities will provide forums in which physics educators can collectively address instructional challenges, share lesson ideas, and continue to grow and develop professionally.